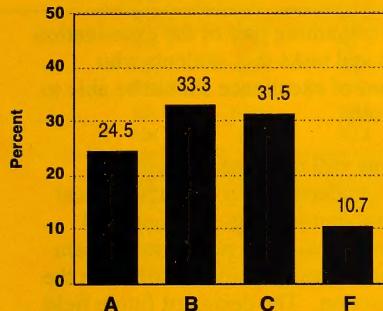


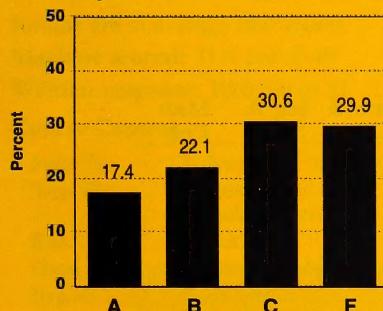
Mathematics 30

Diploma Examination Results Examiners' Report for June 1995

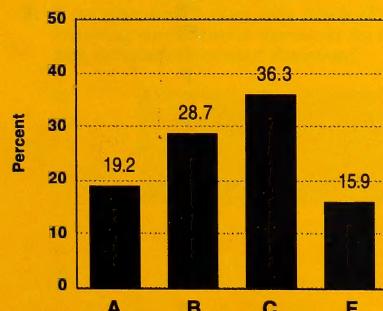
School-Awarded Mark



Diploma Examination Mark



Final Course Mark



The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the June 1995 administration of the Mathematics 30 Diploma Examination. This information is most helpful when used with the detailed school and jurisdiction reports that have been mailed to schools and school jurisdiction offices. An annual provincial report containing a detailed analysis of the combined January, June, and August results is published each year.

Description of the Examination

The Mathematics 30 Diploma Examination consists of three parts: a multiple-choice section of 40 questions worth 57%, a numerical-response section of nine questions worth 13%, and a written-response section of four questions worth 30% of the total examination mark.

Achievement of Standards

The information reported is based on the final course marks achieved by 9 831 students who wrote the June 1995 examination.

- 84.1% of these students achieved the acceptable standard (a final course mark of 50% or higher).
- 19.2% of these students achieved the standard of excellence (a final course mark of 80% or higher).

Approximately 50% of the students who wrote the June 1995 examination were females.

- 83.9% of these students achieved the acceptable standard (a final course mark of 50% or higher).
- 16.8% of these students achieved the standard of excellence (a final course mark of 80% or higher).

Approximately 50% of the students who wrote the June 1995 examination were males.

- 84.3% of these students achieved the acceptable standard (a final course mark of 50% or higher).
- 21.6% of these students achieved the standard of excellence (a final course mark of 80% or higher).

Provincial Averages

- The average school-awarded mark was 67.4%.
- The average diploma examination mark was 60.0%.
- The average final course mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 64.0%.

Of the 9 831 students who wrote the June 1995 examination, 2 581 had written at least one Math 30 exam previously.

Results and Examiners' Comments

This examination has a balance of question types and difficulties reflecting the philosophy of the Mathematics 30 Course of Studies. It was designed so that students who are achieving the acceptable standard in Math 30 should obtain a mark of 50% or higher. Students who are achieving the standard of excellence in Mathematics 30 should obtain a mark of 80% or higher. The student who is achieving the acceptable standard or the standard of excellence is expected to be able to achieve the curriculum standards identified in the *Mathematics 30 Information Bulletin, Diploma Examination Program*. At least 70% of the examination includes questions and tasks that students who achieve the acceptable standard should be able to complete

successfully. The remaining part of the examination includes questions and tasks that students who achieve the standard of excellence should be able to complete successfully.

Future examinations will continue to focus on assessing students' understanding of mathematical concepts and on problem solving. Students will continue to be expected to solve problems, explain solutions, justify solutions, or prove solutions in the written-response section. The design of future field tests and examinations will include items that assess how well students have achieved the general learner expectations stated in the Mathematics 30 Course of Studies.

Blueprint

Question	Key	Difficulty	Poly. Fn.	Trig. Fn.	Stat.	Quad. Rltns.	Exp. & Log.	Perm. & Com.	Seq. & Series	Math Und.
MC 1	D	79.1	✓							P
MC 2	B	78.9	✓							P
MC 3	D	66.2	✓							C
MC 4	A	81.8	✓							C
MC 5	B	62.1	✓							PS
MC 6	A	54.2	✓							C
MC 7	B	86.2	✓							PS
MC 8	C	81.8	✓							PS
MC 9	B	79.3				✓				C
MC 10	A	73.5				✓				PS
MC 11	C	63.4				✓				PS
MC 12	A	56.1				✓				PS
MC 13	C	49.8				✓				PS
MC 14	D	74.8					✓			C
MC 15	A	86.0					✓			P
MC 16	C	48.3					✓			C
MC 17	A	79.0					✓			P
MC 18	D	42.7					✓			P
MC 19	D	64.8						✓		C
MC 20	B	51.9						✓		PS
MC 21	A	66.0							✓	PS
MC 22	D	50.6		✓						PS
MC 23	C	48.9		✓						P
MC 24	A	53.4		✓						P
MC 25	B	35.2		✓						PS
MC 26	D	70.4				✓				C
MC 27	A	66.3				✓				PS
MC 28	A	59.4				✓				C
MC 29	D	78.1				✓				C
MC 30	C	76.9				✓				P
MC 31	A	44.8				✓				PS
MC 32	A	86.8						✓		C

Question	Key	Difficulty	Poly. Fn.	Trig. Fn.	Stat.	Quad. Rltns.	Exp. & Log.	Perm. & Com.	Seq. & Series	Math Und.
MC 33	C	69.9						✓		P
MC 34	A	73.2						✓		C
MC 35	B	62.2						✓		PS
MC 36	D	68.5						✓		PS
MC 37	B	47.9						✓		P
MC 38	C	63.7						✓		P
MC 39	A	49.5						✓		P
MC 40	A	34.2						✓		PS
NR 1	4	75.1	✓							C
NR 2	12.0	45.3	✓							P
NR 3	0.33	60.3							✓	C
NR 4	108	86.0							✓	P
NR 5	14	79.9							✓	P
NR 6	6560	72.4							✓	P
NR 7	132	80.1	✓							P
NR 8	257	27.4	✓							C
NR 9	480	46.5								PS
WR 1	—	59.0					✓			PCPS
WR 2	—	35.0					✓			PCPS
WR 3	—	61.0	✓							PCPS
WR 4	—	38.0							✓	PCPS

Subtest

When analyzing detailed results, please bear in mind that subtest results **cannot** be directly compared.

Results are in average raw scores.

Machine scored: 31.4 out of 49

Written response: 10.6 out of 21

Course Content

Poly. Fn.	Polynomial Functions	7.1	out of	10
Trig. Fn.	Trigonometric and Circular Functions	7.2	out of	13
Stat.	Statistics	3.2	out of	5
Quad. Rltns.	Quadratic Relations	5.4	out of	10
Exp. & Log.	Exponential and Logarithmic Functions	6.9	out of	11

Perm. & Com. Permutations and Combinations
Seq. & Series Sequences and Series

5.6 out of 10

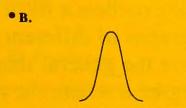
6.1 out of 11

Mathematical Understandings*

- Procedural (P): 11.4 out of 17
- Conceptual (C): 10.0 out of 15
- Problem Solving (PS): 10.0 out of 17

*Refer to Appendix D of the 1994–95 *Mathematics 30 Information Bulletin, Diploma Examinations Program*, for an explanation of mathematical understandings. These are the mathematical abilities described in Appendix D.

9. If the same scale is used, then which of the following normal curves represents the data with the smallest standard deviation?



Multiple-Choice and Numerical-Response Questions

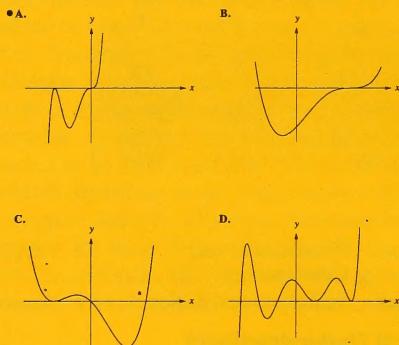
The multiple-choice and numerical-response section of the examination asks a sample of questions that cover all content areas in Mathematics 30. A discussion about how well students meet the curriculum standards in the units Statistics and Polynomial Functions follows.

Statistics — To achieve the curriculum standards for this unit, students should describe the characteristics of normally distributed data, interpret the mean and standard deviation of a set of normally distributed data, apply the standard normal curve and the z -scores of data that are normally distributed, and participate in and contribute toward the problem-solving process for problems that require the analysis of statistics studied in Mathematics 30. Multiple-choice questions 9 to 13 asked students to demonstrate their understanding of this unit. About 60% of the students who achieved the acceptable standard but not the standard of excellence on the

10. The waiting times for patrons entering an auditorium are normally distributed with a mean of 30 min and a standard deviation of 5 min. If 2500 people enter the auditorium, then the number of people having to wait longer than 38 min is

- A. 137
- B. 1113
- C. 1387
- D. 2363

4. If all of the x -intercepts are shown, then which of the following could represent the graph of a fifth-degree integral polynomial function?



Numerical Response

2. The roots of the equation of a third-degree polynomial function $P(x) = ax^3 + bx^2 + cx + d$ are -2 , 1 , and 3 . If the graph of the polynomial function passes through $(0, 12)$, then, correct to the nearest tenth, the value of the **constant**, d , is _____.

(Record your answer on the answer sheet.)

Answer: 12.0

examination were able to achieve the expectations of multiple-choice questions 9 and 11. About 50% of these students were able to achieve the expectations on multiple-choice question 12; whereas, only about 46% of these students achieved the expectations on multiple-choice question 13.

In addition, students who meet the standard of excellence are expected to complete the solution to problems that require the analysis of statistics studied in Mathematics 30. Multiple-choice question 10 asked to students to show that they can do this; 95% of the students who achieved the standard of excellence on the examination were able to demonstrate this on multiple-choice question 10. About 75% of the students who achieved the acceptable standard but not the standard of excellence on the examination were also able to demonstrate this expectation on multiple-choice question 10.

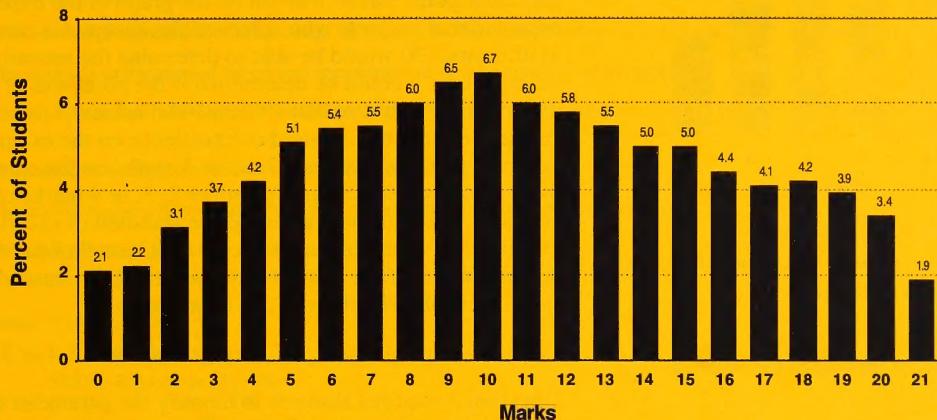
Polynomial Functions — To achieve the acceptable standard in polynomial functions students must be able to recognize and give examples of polynomial functions of different degrees; use the Remainder Theorem to evaluate a third-degree integral polynomial function for rational values of the variable and understand how this can be used to find factors of the polynomial function; factor and find the zeros of an integral polynomial function in standard form, degree 3 or less, in which all zeros are rational; recognize the general shape of graphs of integral polynomial functions of degree 4 or less where the multiplicity of zeros is one, two, or three; and determine the minimum degree of a polynomial function by using the multiplicities of its zeros. Multiple-choice questions 1 to 8 and numerical-response questions 1 and 2 ask students to demonstrate their understanding of this unit. About 80% of the students who achieved the acceptable standard but not the standard of excellence on the examination were able to correctly answer multiple-choice questions 1, 2, and 7 and numerical-response question 1; about 65% achieved the expectations on multiple-choice question 3; about 60% met the expectations on multiple-choice question 5; about 52% achieved the expectations on multiple-choice question 6; and only 41% achieved the expectations on numerical-response question 2.

In addition to the expectations for the acceptable standard, students who achieve the standard of excellence must be able to explain the relationships between the graphs of different polynomial functions and their zeros and recognize the general shape of graphs of integral polynomial functions of degree n where the multiplicity of zeros is greater than two. Multiple-choice questions 4 and 8 asks this of students. About 95% of the students who met the standard of excellence on the examination correctly answered these questions, while 83% of the students who achieved the acceptable standard but not the standard of excellence on the examination met this expectation.

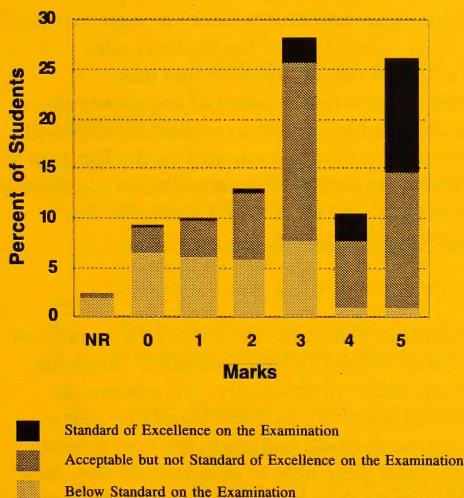
Written-Response Question

Questions in the written-response section dealt with four of the seven content strands for Mathematics 30. Students performing at the acceptable standard were expected to obtain at least half marks on all questions. Students performing at the standard of excellence were expected to answer all questions almost perfectly.

Distribution of Marks for Written Response



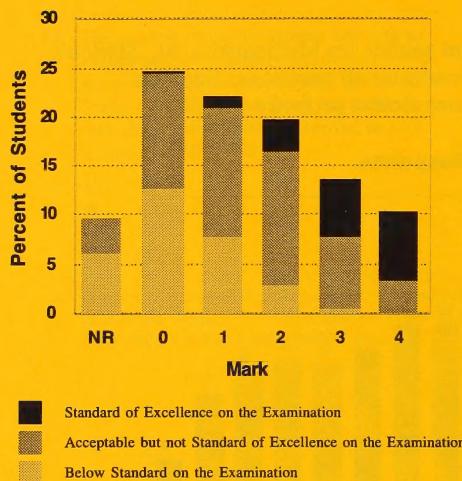
Distribution of Marks for Question 1



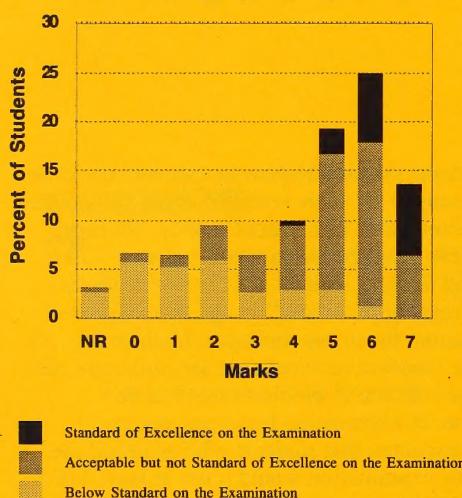
Question 1 required students to describe how an estimate could be made for the value of money in 40 years and then asked students to calculate the actual expected value of a sum of money. Students who achieve the acceptable standard are expected to solve exponential equations and to participate in and contribute toward the problem-solving process for problems that can be represented by logarithmic or exponential functions studied in Mathematics 30. Students who achieve the standard of excellence are also expected to be able to complete the solution to problems that can be represented by logarithmic or exponential functions studied in Mathematics 30. It was expected that students who achieved the acceptable standard on the examination would score at least 3 of 5 marks on this question. Of the students who achieved the acceptable standard on the examination, 66% did receive either 3, 4, or 5 marks on this question. The students, who achieved the standard of excellence on the examination should have obtained 5 of 5 marks on this question. Only 63% of the students who achieved the standard of excellence on the examination achieved this.

On this 5-mark question, the average mark was 2.95 or 59%.

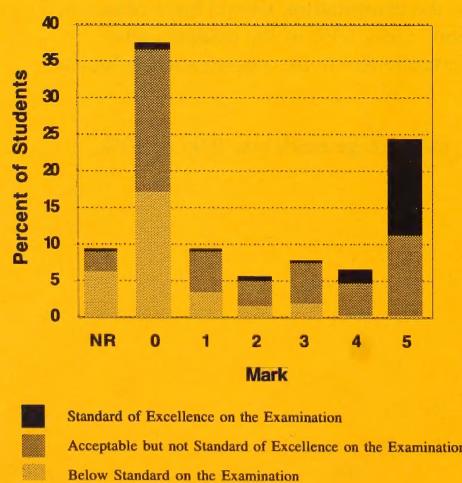
Distribution of Marks for Question 2



Distribution of Marks for Question 3



Distribution of Marks for Question 4



Question 2 All students who achieve the acceptable standard in Mathematics 30 are expected to be able participate in and contribute toward the problem-solving process for problems that require the analysis of quadratic relations studied in Mathematics 30. This question required students to find a second focus and its corresponding directrix for a hyperbola, given its graph. Then, students were asked to describe how one could determine if a particular point was or was not on the graph of the hyperbola. It was expected that students who achieved the acceptable standard in Mathematics 30 would be able to determine the second focus and to describe how it could be determined if the point was or was not on the graph. This meant that students who achieved the acceptable standard but not the standard of excellence on the examination were expected to achieve at least 2 of the 4 marks on this question. Of these students, 39.1% received either 2, 3, or 4 marks on this question. Students who achieved the standard of excellence on the examination were expected to achieve at least 3 of the 4 marks on this question. Of the students who achieved the standard of excellence, 68.5% achieved this expectation.

On this 4-mark question, the average mark was 1.4 or 35%.

Question 3 required students to identify the parameter that had been introduced to the equation of the graph of the sine function and then describe the effects of introducing each parameter on the graph and on the function's domain and range. Students who achieve the acceptable standard in Mathematics 30 are expected to be able to explain the effect of each parameter a , b , c , and d on the graph of the $y = a \sin [b(\theta + c)] + d$. Students who achieved the acceptable standard on the examination were expected to score at least 5 of the 7 marks on this question. Only about 39% of the students who achieved the acceptable standard on examination met this expectation. Students who achieve the standard of excellence in Mathematics 30 are also expected to be able to explain, orally or in writing, the effects of introducing these parameters on the function's domain and range. Students who achieved the standard of excellence on the examination were expected to score 6 or 7 marks on this question. About 81% met this expectation.

On this 7-mark question, the average mark was 4.3 or 61%.

Question 4, required students to determine the value of a variable of a geometric sum with the sum written in sigma notation. Students were asked to determine this value algebraically. To achieve the acceptable standard in Mathematics 30, students should be able to expand a series given in sigma notation and apply the sum formula for geometric series. If students were able to demonstrate this, they were expected to score at least 3 of the 5 marks. About 33% of the students who achieved the acceptable standard but not the standard of excellence on the examination met or exceeded this expectation. Students who achieved the standard of excellence on the examination were expected to complete the algebraic solution and arrive at the correct value of the variable. Of the students who achieved the standard of excellence on the examination, 68.5% met this expectation.

On this 5-mark question, the average mark was 1.9 or 38%.

Scoring Guide for Written-Response Questions

Question 1

Part a

3 In the explanation of the process, the student has carried out the strategy to show how Jean could determine her estimate and then looks back to describe the reasonableness of the answer.

2 In the student's explanation of the process, the student has determined a strategy for Jean to arrive at her estimate.

1 The student's explanation of the process communicates an understanding of the problem.

Notes: Process is a "set of actions" as defined in the *Dictionary of Canadian English — The Senior Dictionary*.

Part b

2 The student correctly determines the value of the money.

1 The student begins a strategy or carries out a strategy that would lead to a correct answer.
OR
A correct answer is given with no supporting work.

Notes: $V(40) = \$2000 \left(\frac{1}{2}\right)^{40/15}$

$V(40) = \$314.98$ or $\$314.99$.

OR

If students round $\frac{40}{15}$ to 2.7, then the resulting answer is $\$307.79$ or $\$307.78$.

OR

If students round $\frac{40}{15}$ to 2.66, then the resulting answer is $\$314.98$.

OR

If students round $\frac{40}{15}$ to 2.67, then the resulting answer is $\$314.25$.

OR

If students round $\frac{40}{15}$ to 2.667, then the resulting answer is $\$314.97$.

Question 2

Part a

2 the student identifies the focus as the point $(-2, -8)$ and the directrix as the line $y = -1.6$ (or $y + 1.6 = 0$).

1 the student either identifies the focus as the point $(-2, -8)$ or identifies the directrix as $y = -1.6$.
OR
the student begins a strategy that could lead to a solution, such as correctly calculating $e = \frac{5}{3}$ or determining the difference in the lengths of the focal radii.

Part b

2 The student clearly communicates a correct process for deciding whether the point $P(-15, 13)$ is on the hyperbola.

1 The student communicates a process; however, the explanation requires the reader to "fill-in" information.

Notes: The ratios $\frac{P_1F}{P_1D}$ and $\frac{P_2F}{P_2D}$ will be equal, since the eccentricity of the hyperbola is constant. Use any point on the hyperbola, say $(-2, 8)$, the focus $(-2, 12)$ and the directrix $y = 5.6$ to determine the eccentricity ratio. Determine the eccentricity ratio using the point $(-15, 13)$. If, when simplified, the ratios are equal, the point $(-15, 13)$ lies on the hyperbola. If the ratios are not equal, the point $(-15, 13)$ does not lie on the hyperbola.
OR

Find the second focus by using symmetry. Using any point on the hyperbola, say $(-2, 8)$, calculate $|\overline{PF_1} - \overline{PF_2}| = K$. This value will stay constant for any point on the hyperbola. Use $(-15, 13)$ as the point and evaluate $|\overline{PF_1} - \overline{PF_2}|$. If

$|\overline{PF_1} - \overline{PF_2}| = K$, then $(-15, 13)$ lies on the hyperbola. If $|\overline{PF_1} - \overline{PF_2}| \neq K$, then the point does not lie on the hyperbola.

**Question 3****Part a**

3 The equations for all 3 graphs are correct:
Graph 2 $y = \sin b\theta$
Graph 3 $y = \sin b(\theta + c)$
Graph 4 $y = a \sin [b(\theta + c)]$

2 The parameters have been introduced in the correct order, b , c , and then a , and in the correct position in the equation, but the equations are not written correctly.
OR
Two equations have been written correctly.

1 The new parameter introduced corresponds to the change in the graph, but the equation is not written correctly.
OR
One equation has been written correctly.

Part b

4 The student clearly explains the effect of introducing each parameter and explain how the introduction of the parameters affect the domain and range.

3 The student clearly explains the effect of introducing each parameter and provides an incomplete explanation of how the introduction of the parameters affects the domain and range.
OR
The student clearly explains how the introduction of the parameters affect the domain and range and provides an incomplete explanation of the effect of introducing each parameter.

2 The student explains the effects of introducing all 4 parameters on the graph of $y = \sin \theta$. (An error that does or does not indicate a misunderstanding of a parameter can occur in the explanation).
OR
The student indicates which parameters affect either the range or the domain.

1 The student describes the effects of introducing at least one parameter on the graph of $y = \sin \theta$.
OR
The student identifies the terminology associated with the four parameters.

Question 4

5 The student carries through on an algebraic strategy that leads to the solution $K = 20$.

4 The student carries through on an algebraic strategy that could have led to the solution $K = 20$; however, the student arrives at an incorrect or incomplete solution.

3 The student begins an algebraic strategy that is related to arithmetic series but does not carry it through. The strategy could lead to the solution $K = 20$.
OR
The student selects a non-algebraic strategy and carries it through to a correct solution of $K = 20$.

2 The student demonstrates that this is an arithmetic series; that is, the student demonstrates some knowledge of sigma notation. For example, the student writes $4 + 8 + 12 + \dots$.
OR
The student demonstrates that this is an arithmetic sequence and arrives at a correct answer; however, there is no support for how the answer was arrived at.

1 The student demonstrates in some way that this is an arithmetic sequence. For example, the student shows $d = 4$ and $t_1 = 4$ or generates at least the first three terms of the sequence.
OR
The student arrives at a correct solution with no supporting evidence.

Notes: The word "algebraically" means that students must show a generalized approach to determining the solution.

For further information, contact Marion Florence or Yvonne Johnson at the Student Evaluation Branch, 403-427-0010.

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